

TOXICOLOGICAL PROFILE FOR STRONTIUM

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry**

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UPDATE STATEMENT

Toxicological profiles are revised and republished as necessary, but no less than once every three years. For information regarding the update status of previously released profiles, contact ATSDR at:

Agency for Toxic Substances and Disease Registry
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FOREWORD

This toxicological profile is prepared in accordance with guidelines developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The original guidelines were published in the *Federal Register* on April 17, 1987. Each profile will be revised and republished as necessary.

The ATSDR toxicological profile succinctly characterizes the toxicologic and adverse health effects information for the hazardous substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicologic properties. Other pertinent literature is also presented, but is described in less detail than the key studies. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced.

The focus of the profiles is on health and toxicologic information; therefore, each toxicological profile begins with a public health statement that describes, in nontechnical language, a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to protection of public health are identified by ATSDR and EPA.

Each profile includes the following:

- (A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a hazardous substance to ascertain the levels of significant human exposure for the substance and the associated acute, subacute, and chronic health effects;
- (B) A determination of whether adequate information on the health effects of each substance is available or in the process of development to determine levels of exposure that present a significant risk to human health of acute, subacute, and chronic health effects; and
- (C) Where appropriate, identification of toxicologic testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

The principal audiences for the toxicological profiles are health professionals at the Federal, State, and local levels; interested private sector organizations and groups; and members of the public. We plan to revise these documents in response to public comments and as additional data become available. Therefore, we encourage comments that will make the toxicological profile series of the greatest use.

Comments should be sent to:

Agency for Toxic Substances and Disease Registry
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Background Information

The toxicological profiles are developed by ATSDR pursuant to Section 104(i) (3) and (5) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) for hazardous substances found at Department of Energy (DOE) waste sites. CERCLA directs ATSDR to prepare toxicological profiles for hazardous substances most commonly found at facilities on the CERCLA National Priorities List (NPL) and that pose the most significant potential threat to human health, as determined by ATSDR and the EPA. ATSDR and DOE entered into a Memorandum of Understanding on November 4, 1992 which provided that ATSDR would prepare toxicological profiles for hazardous substances based upon ATSDR's or DOE's identification of need. The current ATSDR priority list of hazardous substances at DOE NPL sites was announced in the Federal Register on July 24, 1996 (61 FR 38451).

This profile reflects ATSDR's assessment of all relevant toxicologic testing and information that has been peer-reviewed. Staff of the Centers for Disease Control and Prevention and other Federal scientists have also reviewed the profile. In addition, this profile has been peer-reviewed by a nongovernmental panel and is being made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.



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QUICK REFERENCE FOR HEALTH CARE PROVIDERS

Toxicological Profiles are a unique compilation of toxicological information on a given hazardous substance. Each profile reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicologic and epidemiologic information on a substance. Health care providers treating patients potentially exposed to hazardous substances will find the following information helpful for fast answers to often-asked questions.

Primary Chapters/Sections of Interest

Chapter 1: Public Health Statement: The Public Health Statement can be a useful tool for educating patients about possible exposure to a hazardous substance. It explains a substance's relevant toxicologic properties in a nontechnical, question-and-answer format, and it includes a review of the general health effects observed following exposure.

Chapter 2: Relevance to Public Health: The Relevance to Public Health Section evaluates, interprets, and assesses the significance of toxicity data to human health.

Chapter 3: Health Effects: Specific health effects of a given hazardous compound are reported by *type of health effect* (death, systemic, immunologic, reproductive), by *route of exposure*, and by *length of exposure* (acute, intermediate, and chronic). In addition, both human and animal studies are reported in this section.

NOTE: Not all health effects reported in this section are necessarily observed in the clinical setting. Please refer to the Public Health Statement to identify general health effects observed following exposure.

Pediatrics: Four new sections have been added to each Toxicological Profile to address child health issues:

Section 1.7	How Can (Chemical X) Affect Children?
Section 1.8	How Can Families Reduce the Risk of Exposure to (Chemical X)?
Section 3.7	Children's Susceptibility
Section 6.6	Exposures of Children

Other Sections of Interest:

Section 3.8	Biomarkers of Exposure and Effect
Section 3.11	Methods for Reducing Toxic Effects

ATSDR Information Center

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E-mail: atsdric@cdc.gov **Internet:** <http://www.atsdr.cdc.gov>

The following additional material can be ordered through the ATSDR Information Center:

Case Studies in Environmental Medicine: Taking an Exposure History—The importance of taking an exposure history and how to conduct one are described, and an example of a thorough exposure history is provided. Other case studies of interest include *Reproductive and Developmental Hazards*; *Skin Lesions and Environmental Exposures*; *Cholinesterase-Inhibiting Pesticide Toxicity*; and numerous chemical-specific case studies.

Managing Hazardous Materials Incidents is a three-volume set of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident. Volumes I and II are planning guides to assist first responders and hospital emergency department personnel in planning for incidents that involve hazardous materials. Volume III—*Medical Management Guidelines for Acute Chemical Exposures*—is a guide for health care professionals treating patients exposed to hazardous materials.

Fact Sheets (ToxFAQs) provide answers to frequently asked questions about toxic substances.

Other Agencies and Organizations

The National Center for Environmental Health (NCEH) focuses on preventing or controlling disease, injury, and disability related to the interactions between people and their environment outside the workplace. *Contact:* NCEH, Mailstop F-29, 4770 Buford Highway, NE, Atlanta, GA 30341-3724 • Phone: 770-488-7000 • FAX: 770-488-7015.

The National Institute for Occupational Safety and Health (NIOSH) conducts research on occupational diseases and injuries, responds to requests for assistance by investigating problems of health and safety in the workplace, recommends standards to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and trains professionals in occupational safety and health. *Contact:* NIOSH, 200 Independence Avenue, SW, Washington, DC 20201 • Phone: 800-356-4674 or NIOSH Technical Information Branch, Robert A. Taft Laboratory, Mailstop C-19, 4676 Columbia Parkway, Cincinnati, OH 45226-1998 • Phone: 800-35-NIOSH.

The National Institute of Environmental Health Sciences (NIEHS) is the principal federal agency for biomedical research on the effects of chemical, physical, and biologic environmental agents on human health and well-being. *Contact:* NIEHS, PO Box 12233, 104 T.W. Alexander Drive, Research Triangle Park, NC 27709 • Phone: 919-541-3212.

Radiation Emergency Assistance Center/Training Site (REAC/TS) provides support to the U.S. Department of Energy, the World Health Organization, and the International Atomic Energy Agency in the medical management of radiation accidents. A 24-hour emergency response program at the Oak Ridge Institute for Science and Education (ORISE), REAC/TS trains, consults, or assists in the response to all kinds of radiation accidents. *Contact:* Oak Ridge Institute for Science and Education, REAC/TS, PO Box 117, MS 39, Oak Ridge, TN 37831-0117 • Phone 865-576-3131 • FAX 865-576-9522 • 24-Hour Emergency Phone 865-576-1005 (ask for REAC/TS) • e-mail: cooleyp@orau.gov • website (including emergency medical guidance): <http://www.orau.gov/reacts/default.htm>

Referrals

The Association of Occupational and Environmental Clinics (AOEC) has developed a network of clinics in the United States to provide expertise in occupational and environmental issues. *Contact:* AOEC, 1010 Vermont Avenue, NW, #513, Washington, DC 20005 • Phone: 202-347-4976 • FAX: 202-347-4950 • e-mail: aoec@dgs.dgsys.com • AOEC Clinic Director: <http://occ-env-med.mc.duke.edu/oem/aoec.htm>.

The American College of Occupational and Environmental Medicine (ACOEM) is an association of physicians and other health care providers specializing in the field of occupational and environmental medicine. *Contact:* ACOEM, 55 West Seegers Road, Arlington Heights, IL 60005 • Phone: 847-818-1800 • FAX: 847-818-9266.

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THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

1. Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.
2. Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific minimal risk levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.
3. Data Needs Review. The Research Implementation Branch reviews data needs sections to assure consistency across profiles and adherence to instructions in the Guidance.

PEER REVIEW

A peer review panel was assembled for strontium. The panel consisted of the following members:

1. Adele L. Boskey, Ph.D., Professor of Biochemistry and Cell and Molecular Biology, Director of Research Hospital for Special Surgery, Weill Medical College of Cornell University, New York, New York,
2. Marvin Goldman, Ph.D., Emeritus Professor of Radiation Biology, Department of Surgical and Radiological Sciences, University of California, Davis, California,
3. Bruce Muggenburg, D.V.M., Ph.D., Senior Scientist and Veterinary Physiologist, Toxicology Division, Lovelace Respiratory Research Institute, Albuquerque, New Mexico, and
4. Robert B. Rucker, Ph.D., Professor of Nutrition and Biological Chemistry, University of California, Davis, California.

These experts collectively have knowledge of strontium's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(I)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.

CONTENTS

FOREWORD	v
QUICK REFERENCE FOR HEALTH CARE PROVIDERS	vii
CONTRIBUTORS	xi
PEER REVIEW	xiii
LIST OF FIGURES	xix
LIST OF TABLES	xxi
1. PUBLIC HEALTH STATEMENT	1
1.1 WHAT IS STRONTIUM?	1
1.2 WHAT HAPPENS TO STRONTIUM WHEN IT ENTERS THE ENVIRONMENT?	3
1.3 HOW MIGHT I BE EXPOSED TO STRONTIUM?	5
1.4 HOW CAN STRONTIUM ENTER AND LEAVE MY BODY?	6
1.5 HOW CAN STRONTIUM AFFECT MY HEALTH?	7
1.6 HOW CAN STRONTIUM AFFECT CHILDREN?	10
1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO STRONTIUM?	12
1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO STRONTIUM?	13
1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?	13
1.10 WHERE CAN I GET MORE INFORMATION?	15
2. RELEVANCE TO PUBLIC HEALTH	17
2.1 BACKGROUND AND ENVIRONMENTAL EXPOSURES TO STRONTIUM IN THE UNITED STATES	17
2.2 SUMMARY OF HEALTH EFFECTS	19
2.3 MINIMAL RISK LEVELS	29
3. HEALTH EFFECTS	33
3.1 INTRODUCTION	33
3.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE	35
3.2.1 Inhalation Exposure	37
3.2.1.1 Death	38
3.2.1.2 Systemic Effects	44
3.2.1.3 Immunological and Lymphoreticular Effects	50
3.2.1.4 Neurological Effects	51
3.2.1.5 Reproductive Effects	52
3.2.1.6 Developmental Effects	52
3.2.1.7 Cancer	52
3.2.2 Oral Exposure	54
3.2.2.1 Death	55
3.2.2.2 Systemic Effects	67
3.2.2.3 Immunological and Lymphoreticular Effects	95

3.2.2.4	Neurological Effects	96
3.2.2.5	Reproductive Effects	97
3.2.2.6	Developmental Effects	98
3.2.2.7	Cancer	100
3.2.3	Dermal Exposure	104
3.2.3.1	Death	104
3.2.3.2	Systemic Effects	104
3.2.3.3	Immunological and Lymphoreticular Effects	104
3.2.3.4	Neurological Effects	104
3.2.3.5	Reproductive Effects	105
3.2.3.6	Developmental Effects	105
3.2.3.7	Cancer	105
3.2.4	External Exposure	105
3.2.4.1	Death	105
3.2.4.2	Systemic Effects	105
3.2.4.3	Immunological and Lymphoreticular Effects	112
3.2.4.4	Neurological Effects	112
3.2.4.5	Reproductive Effects	112
3.2.4.6	Developmental Effects	112
3.2.4.7	Cancer	112
3.2.5	Other Routes of Exposure	113
3.2.5.1	Death	114
3.2.5.2	Systemic Effects	114
3.2.5.3	Immunological and Lymphoreticular Effects	117
3.2.5.4	Neurological Effects	117
3.2.5.5	Reproductive Effects	118
3.2.5.6	Developmental Effects	119
3.2.5.7	Cancer	120
3.3	GENOTOXICITY	121
3.4	TOXICOKINETICS	125
3.4.1	Absorption	125
3.4.1.1	Inhalation Exposure	125
3.4.1.2	Oral Exposure	127
3.4.1.3	Dermal Exposure	131
3.4.2	Distribution	131
3.4.2.1	Inhalation Exposure	131
3.4.2.2	Oral Exposure	132
3.4.2.3	Dermal Exposure	136
3.4.3	Metabolism	136
3.4.3.1	Inhalation Exposure	136
3.4.3.2	Oral Exposure	136
3.4.3.3	Dermal Exposure	136
3.4.4	Elimination and Excretion	136
3.4.4.1	Inhalation Exposure	136
3.4.4.2	Oral Exposure	137
3.4.4.3	Dermal Exposure	138
3.4.5	Physiologically Based Pharmacokinetic (PBPK)/Pharmacodynamic (PD) Models	139
3.5	MECHANISMS OF ACTION	154
3.5.1	Pharmacokinetic Mechanisms	154
3.5.2	Mechanisms of Toxicity	157

3.5.3	Animal-to-Human Extrapolations	161
3.6	ENDOCRINE DISRUPTION	161
3.7	CHILDREN'S SUSCEPTIBILITY	162
3.8	BIOMARKERS OF EXPOSURE AND EFFECT	168
3.8.1	Biomarkers Used to Identify or Quantify Exposure to Strontium	169
3.8.2	Biomarkers Used to Characterize Effects Caused by Strontium	169
3.9	INTERACTIONS WITH OTHER CHEMICALS	170
3.10	POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE	171
3.11	METHODS FOR REDUCING TOXIC EFFECTS	173
3.11.1	Reducing Peak Absorption Following Exposure	173
3.11.2	Reducing Body Burden	175
3.11.3	Interfering with the Mechanism of Action for Toxic Effects	178
3.12	ADEQUACY OF THE DATABASE	179
3.12.1	Existing Information on Health Effects of Strontium	179
3.12.2	Identification of Data Needs	182
3.12.3	Ongoing Studies	193
4.	CHEMICAL AND PHYSICAL INFORMATION	195
4.1	CHEMICAL IDENTITY	195
4.2	PHYSICAL, CHEMICAL, AND RADIOLOGICAL PROPERTIES	195
5.	PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL	205
5.1	PRODUCTION	205
5.2	IMPORT/EXPORT	206
5.3	USE	206
5.4	DISPOSAL	207
6.	POTENTIAL FOR HUMAN EXPOSURE	211
6.1	OVERVIEW	211
6.2	RELEASES TO THE ENVIRONMENT	213
6.2.1	Air	213
6.2.2	Water	221
6.2.3	Soil and Sediments	221
6.3	ENVIRONMENTAL FATE	222
6.3.1	Transport and Partitioning	222
6.3.2	Transformation and Degradation	226
6.3.2.1	Air	226
6.3.2.2	Water	226
6.3.2.3	Soils and Sediments	227
6.4	LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT	227
6.4.1	Air	227
6.4.2	Water	229
6.4.3	Soils and sediments	230
6.4.4	Other Environmental Media	235
6.5	GENERAL POPULATION AND OCCUPATIONAL EXPOSURE	243
6.6	EXPOSURES OF CHILDREN	246
6.7	POPULATIONS WITH POTENTIALLY HIGH EXPOSURES	247
6.8	ADEQUACY OF THE DATABASE	248
6.8.1	Identification of Data Needs	248
6.8.2	Ongoing Studies.	250

7. ANALYTICAL METHODS	253
7.1 BIOLOGICAL MATERIALS	253
7.1.1 Internal Strontium Measurements	255
7.1.2 <i>In Vivo</i> and <i>In Vitro</i> Radiostrontium Measurements	255
7.2 ENVIRONMENTAL SAMPLES	256
7.2.1 Field Measurements of Radiostrontium	256
7.2.2 Laboratory Analysis of Environmental Samples	256
7.3 ADEQUACY OF THE DATABASE	258
7.3.1 Identification of Data Needs	258
7.3.2 Ongoing Studies	259
8. REGULATIONS AND ADVISORIES	261
9. REFERENCES	283
10. GLOSSARY	367

APPENDICES

A. ATSDR MINIMAL RISK LEVELS AND WORKSHEETS	A-1
B. USER'S GUIDE	B-1
C. ACRONYMS, ABBREVIATIONS, AND SYMBOLS	C-1
D. OVERVIEW OF BASIC RADIATION PHYSICS, CHEMISTRY AND BIOLOGY	D-1

LIST OF FIGURES

3-1.	Levels of Significant Exposure to Strontium—Radiation Toxicity—Inhalation	43
3-2.	Levels of Significant Exposure to Strontium—Chemical Toxicity—Oral	62
3-3.	Levels of Significant Exposure to Strontium—Radiation Toxicity—Oral	76
3-4.	Conceptual Representation of a Physiologically Based Pharmacokinetic (PBPK) Model for a Hypothetical Chemical Substance	141
3-5.	Respiratory Tract Compartments in Which Particles May be Deposited	142
3-6.	Reaction of Gases or Vapors at Various Levels of the Gas-Blood Interface	147
3-7.	Compartment Model to Represent Time-Dependent Particle Transport in the Respiratory Tract	148
3-8.	The Human Respiratory Tract Model: Absorption into Blood	151
3-9.	ICRP (1993) Model of Strontium Biokinetics	153
3-10.	Existing Information on Health Effects of Stable Strontium	180
3-11.	Existing Information on Health Effects of Radioactive Strontium	181
6-1.	Frequency of NPL Sites with Strontium Contamination	212
6-2.	Major DOE Offices, Facilities, and Laboratories	220
6-3.	U.S. Daily Dietary Intake of ⁹⁰ Sr, 1961–1992	242

LIST OF TABLES

3-1.	Levels of Significant Exposure to Strontium—Radiation Toxicity—Inhalation	40
3-2.	Levels of Significant Exposure to Strontium—Chemical Toxicity—Oral	57
3-3.	Levels of Significant Exposure to Strontium—Radiation Toxicity—Oral	68
3-4.	Levels of Significant Exposure to Strontium—Radiation Toxicity—External	107
3-5.	Genotoxicity of Stable and Radioactive Strontium <i>In Vivo</i>	122
3-6.	Genotoxicity of Stable and Radioactive Strontium <i>In Vitro</i>	123
3-7.	Summary of Estimates of Absorption of Ingested Strontium in Humans	128
3-8.	Reference Respiratory Values for a General Caucasian Population at Different Levels of Activity	144
3-9.	Reference Values of Parameters for the Compartment Model to Represent Time-dependent Particle Transport from the Human Respiratory Tract	145
4-1.	Chemical Identity of Strontium and Strontium Compounds	196
4-2.	Physical and Chemical Properties of Strontium and Strontium Compounds	199
4-3.	Percent Natural Occurrence and Radioactive Properties of Isotopes of Strontium	202
6-1.	Radiostrontium Releases from Nuclear Power Plants for 1993	215
6-2.	Selected Bioconcentration Factors for ⁹⁰ Sr in Aquatic, Wetland, and Terrestrial Ecosystems at the Savannah River Site	225
6-3.	Average or Ranges of Concentration of Strontium in Earth Materials	228
6-4.	⁹⁰ Sr in Drinking Water (Composites) for January–December 1995	231
6-5.	Quarterly and Annual Deposition of ⁹⁰ Sr in Selected U.S. Cites for the Year 1990	234
6-6.	Concentration of Strontium in Fruit Juices and Produce	236
6-7.	⁹⁰ Sr in the Human Diets During 1982	238
6-8.	⁹⁰ Sr in Pasteurized Milk in July 1997	240
6-9.	Strontium Concentrations in Human Body Fluids and Tissues	245
6-10.	Ongoing Studies on Environmental Effects of Strontium	251
7-1.	Analytical Methods for Determining Strontium in Biological Samples	254
7-2.	Analytical Methods for Determining Strontium in Environmental Samples	257
8-1.	Regulations and Guidelines Applicable to Stable Strontium	265
8-2.	Regulations and Guidelines Applicable to Radioactive Strontium	267
8-3.	Effective Dose Coefficients (e(50)) and Annual Limits on Intake (ALI) for Occupational Exposures to Radioactive Strontium Isotopes	281